IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

State of Oklahoma, Plaintiffs, vs. Tyson Foods, Inc., et al., Defendants.	**Case No. 4:05-cv-00329-GKF-PJC**

DECLARATION OF BRIAN L. MURPHY, PH.D.

I, Brian L. Murphy, Ph.D., hereby state as follows:

1. Since July 1, 2002, I have been a Principal Scientist at Exponent, Inc., an engineering and science consulting firm. I received Ph.D. and M.S. degrees in 1966 and 1963 from Yale University and a Sc.B. from Brown University in 1961.
2. My consulting practice focuses on mathematical modeling, applications of environmental forensics techniques, and dose reconstruction. I have more than 30 years of experience in data analysis and mathematical modeling of pollutant fate and transport in various media and am the author of more than 30 journal publications, as well as numerous technical reports and presentations. I am also co-editor of the Academic Press texts *Introduction to Environmental Forensics* and *Environmental Forensics: Contaminant Specific Guide*, and am on the editorial board of the journal *Environmental Forensics*. I am also coauthor of the book *Controlling Volatile Emissions at Hazardous Waste Sites*, published by Noyes Data Corporation of New Jersey.
3. I have been retained by Faegre & Benson LLP, on behalf of Cargill Inc. and Cargill Turkey Production LLC, to provide opinions in the above captioned matter. Specifically,

Exhibit E

I was asked to examine Dr. Roger Olsen's report, affidavit, deposition testimony, and related documents in this case, in order to determine: (a) whether the data set used by Dr. Olsen for the Cargill contract turkey growers was sufficient to support the implication that they are responsible for determinable downstream concentrations; (b) whether the statistical analysis performed by Dr. Olsen, known as principal components analysis, or PCA—which leads him to conclude that poultry growers generally are a determinable source of downstream chemical and bacterial concentrations—was conducted and interpreted in an appropriate manner; and (c) if the statistical analysis were conducted in an appropriate manner, whether it supports a conclusion that any Cargill contract grower or any other grower is responsible for determinable downstream concentrations.

4. I previously authored and submitted to my client an expert report detailing my work and conclusions in this matter. I understand that this report was served on Plaintiffs on January 27, 2009. I incorporate that report herein by reference.

5. If called to testify at trial, I would testify consistent with the opinions expressed in that report.

6. I have reviewed the State of Oklahoma's Motion In Limine to Preclude Expert Testimony of Defendants' Witness Brian Murphy and Integrated Brief In Support Thereof, as well as the Declaration of Jim C. Loftis, Ph.D., P.E. (See Docket No. 2074.)

7. Dr. Loftis wrongly asserts that multimedia analysis is not appropriate in an IRW study "because PCA takes advantage of relationships or correlations among variables, and these relationships will be much different in the solid phase than the liquid phase." (Loftis Decl., ¶ 9.) As Dr. Olsen's own report makes clear this situation is inherently multimedia because the putative source, poultry litter, is solid and the location of concern, downstream waters, is liquid. My fundamental criticism of Dr. Olsen's principal

components analysis (PCA) is that he does not include both the supposed source and the location of concern in a single calculation, rather than the specific lack of a multimedia analysis. At my deposition I outlined two ways, in addition to a multimedia analysis, that source and receptor could be included in the same analysis: (1) Use of the synthetic precipitation leachate procedure (SPLP) samples to characterize poultry litter leachate and cattle manure leachate in a liquids-only PCA, and (2) Obtain edge-of-field runoff samples from fields without litter application for comparison with edge-of-field runoff from fields where poultry litter has been applied.

8. Multimedia analysis incorporates both source and transport/fate features. A PCA scores plot identifies samples influenced by the same source or similar transport and fate mechanisms by their close proximity in the multidimensional principal component (PC) scores space. For example, as I state in my Expert Report, the first multimedia PC (MM-PC1) primarily distinguishes between media. The second multimedia PC (MM-PC2) separates the multiple solid media types, namely poultry litter, cattle manure, and soil and sediment. In addition, it distinguishes (SPLP) samples for poultry litter from the other liquid media samples. The third component (MM-PC3) produces further separation among sample types based on bacterial types. There are also smaller distinctions in PC3, which appear to separate flowing water (surface water and groundwater) from non-flowing water (lake water).

9. Multimedia analysis can provide source information.[1] As I stated in my Expert Report,

[1] Mudge, S.M., 2007, Multivariate Statistical Methods in Environmental Forensics, Environmental Forensics 8:155-163; For further examples: H. Fiedler, C. Lau, L,-O. Kjeller, and C. Rappe, Patterns and sources of polychlorinated dibenzo-p-dioxin and dibenzofuran found in soil and sediment samples in southern Mississippi, Chemosphere **32**, 421-432 (1996); or R.J. Wenning, D.J. Paustenbach, M.A. Harris, and H. Bedbury, Principal components analysis of potential sources of polychlorinated dibenzo-p-dioxin and dibenzofuran residues in surficial sediments from Newark Bay, New Jersey, Arch. Environ. Contam. Toxicol. **24**, 271-289 (1993).

"The multimedia analysis implicates native soils and cattle manure as likely sources of the analytes indicated as important by Dr. Olsen." I based these conclusions on the fact that edge of field samples plot on a scores plot between soils and surface water samples, probably due to dissolved and suspended soils in the edge of field runoff and on the fact that some cattle manure samples plot in the same region of the scores plot as the edge of field samples, suggesting that they are affecting the edge of field results.

10. PCA is a widely used method that is reliable when performed and interpreted correctly. PCA provides a comprehensive overview of the interdependencies amongst the chemicals measured in the samples analyzed.[2] I use it to "see what is going on at a site…" but then may use other methods, particularly to present my findings. PCA involves complex mathematics, and therefore can be difficult to explain to most people unfamiliar with the level of mathematics required. The PCs resulting from a PCA are mathematical artifacts derived from the decomposition of a covariance or correlation matrix. PCA requires the PCs to be perpendicular to each other in a space which can be more than three dimensions. This requirement means that the PCs do not generally correspond to real entities such as sources. Because PCs do not represent sources they frequently include negative contributions for some chemicals.

11. If turkey litter application were a significant source, my analysis would distinguish between fields with and without turkey litter application. If some of the downstream and downgradient samples were significantly affected by turkey litter application, those samples would separate from the other downstream and downgradient samples unaffected by litter application on the PCA scores plots. This was not the case. In my multimedia analysis all of the downstream and downgradient samples were clustered with the other

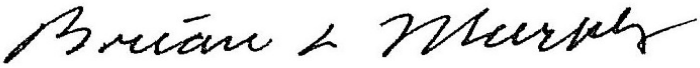
[2] Mudge, S.M., 2007, at 8:155-163.

liquid samples and separated from the poultry litter SPLP samples. Therefore, inclusion of data downstream or downgradient of fields where no litter was applied does not dilute or undermine findings for fields where it was applied.

12. It is not necessary to perform mass balance calculations or chemical transport calculations to perform a PCA.[3] These methods are entirely separate. They have no bearing on the mathematical calculations comprising the PCA.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on June 5, 2009



Brian L. Murphy, Ph.D.

[3] For example, see Johnson, G.W., R. Ehrlich, W. Full, and S. Ramos (2007) Principal Component Analysis and Receptor Models in Environmental Forensics in Introduction to Environmental Forensics, Second Edition, B. Murphy and R. Morrison, Eds., Academic Press.